PRACTICE PROBLEMS

1 Investors should use a portfolio approach to:
   A reduce risk.
   B monitor risk.
   C eliminate risk.

2 Which of the following is the *best* reason for an investor to be concerned with the composition of a portfolio?
   A Risk reduction.
   B Downside risk protection.
   C Avoidance of investment disasters.

3 With respect to the formation of portfolios, which of the following statements is *most accurate*?
   A Portfolios affect risk less than returns.
   B Portfolios affect risk more than returns.
   C Portfolios affect risk and returns equally.

4 Which of the following institutions will *on average* have the greatest need for liquidity?
   A Banks.
   B Investment companies.
   C Non-life insurance companies.

5 Which of the following institutional investors will *most likely* have the longest time horizon?
   A Defined benefit plan.
   B University endowment.
   C Life insurance company.

6 A defined benefit plan with a large number of retirees is *likely* to have a high need for
   A income.
   B liquidity.
   C insurance.

7 Which of the following institutional investors is *most likely* to manage investments in mutual funds?
   A Insurance companies.
   B Investment companies.
   C University endowments.

8 With respect to the portfolio management process, the asset allocation is determined in the:
   A planning step.
   B feedback step.
   C execution step.

9 The planning step of the portfolio management process is *least likely* to include an assessment of the client's

A securities.

B constraints.

C risk tolerance.

10 With respect to the portfolio management process, the rebalancing of a portfolio's composition is *most likely* to occur in the:

A planning step.

B feedback step.

C execution step.

11 An analyst gathers the following information for the asset allocations of three portfolios:

Portfolio	Fixed Income (%)	Equity (%)	Alternative Assets (%)
1	25	60	15
2	60	25	15
3	15	60	25

Which of the portfolios is *most likely* appropriate for a client who has a high degree of risk tolerance?

A Portfolio 1.

B Portfolio 2.

C Portfolio 3.

12 Which of the following investment products is *most likely* to trade at their net asset value per share?

A Exchange traded funds.

B Open-end mutual funds.

C Closed-end mutual funds.

13 Which of the following financial products is *least likely* to have a capital gain distribution?

A Exchange traded funds.

B Open-end mutual funds.

C Closed-end mutual funds.

14 Which of the following forms of pooled investments is subject to the *least* amount of regulation?

A Hedge funds.

B Exchange traded funds.

C Closed-end mutual funds.

15 Which of the following pooled investments is *most likely* characterized by a few large investments?

A Hedge funds.

B Buyout funds.

C Venture capital funds.

SOLUTIONS

1 A is correct. Combining assets into a portfolio should reduce the portfolio's volatility. Specifically, "individuals and institutions should hold portfolios to reduce risk." As illustrated in the reading, however, risk reduction may not be as great during a period of dramatic economic change.

2 A is correct. Combining assets into a portfolio should reduce the portfolio's volatility. The portfolio approach does not necessarily provide downside protection or guarantee that the portfolio always will avoid losses.

3 B is correct. As illustrated in the reading, portfolios reduce risk more than they increase returns.

4 A is correct. The excess reserves invested by banks need to be relatively liquid. Although investment companies and non-life insurance companies have high liquidity needs, the liquidity need for banks is on average the greatest.

5 B is correct. Most foundations and endowments are established with the intent of having perpetual lives. Although defined benefit plans and life insurance companies have portfolios with a long time horizon, they are not perpetual.

6 A is correct. Income is necessary to meet the cash flow obligation to retirees. Although defined benefit plans have a need for income, the need for liquidity typically is quite low. A retiree may need life insurance; however, a defined benefit plan does not need insurance.

7 B is correct. Investment companies manage investments in mutual funds. Although endowments and insurance companies may own mutual funds, they do not issue or redeem shares of mutual funds.

8 C is correct. The client's objectives and constraints are established in the investment policy statement and are used to determine the client's target asset allocation, which occurs in the execution step of the portfolio management process.

9 A is correct. Securities are analyzed in the execution step. In the planning step, a client's objectives and constraints are used to develop the investment policy statement.

10 B is correct. Portfolio monitoring and rebalancing occurs in the feedback step of the portfolio management process.

11 C is correct. Portfolio 3 has the same equity exposure as Portfolio 1 and has a higher exposure to alternative assets, which have greater volatility (as discussed in the section of the reading comparing the endowments from Yale University and the University of Virginia).

12 B is correct. Open-end funds trade at their net asset value per share, whereas closed-end funds and exchange traded funds can trade at a premium or a discount.

13 A is correct. Exchange traded funds do not have capital gain distributions. If an investor sells shares of an ETF (or open-end mutual fund or closed-end mutual fund), the investor may have a capital gain or loss on the shares sold; however, the gain (or loss) from the sale is not a distribution.

14 A is correct. Hedge funds are currently exempt from the reporting requirements of a typical public investment company.

15 B is correct. Buyout funds or private equity firms make only a few large investments in private companies with the intent of selling the restructured companies in three to five years. Venture capital funds also have a short time horizon; however, these funds consist of many small investments in companies with the expectation that only a few will have a large payoff (and that most will fail).

PRACTICE PROBLEMS

1 An investor purchased 100 shares of a stock for $34.50 per share at the beginning of the quarter. If the investor sold all of the shares for $30.50 per share after receiving a $51.55 dividend payment at the end of the quarter, the holding period return is *closest* to:

A −13.0%.

B −11.6%.

C −10.1%.

2 An analyst obtains the following annual rates of return for a mutual fund:

Year	Return (%)
2008	14
2009	−10
2010	−2

The fund's holding period return over the three-year period is *closest* to:

A 0.18%.

B 0.55%.

C 0.67%.

3 An analyst observes the following annual rates of return for a hedge fund:

Year	Return (%)
2008	22
2009	−25
2010	11

The hedge fund's annual geometric mean return is *closest* to:

A 0.52%.

B 1.02%.

C 2.67%.

4 Which of the following return calculating methods is *best* for evaluating the annualized returns of a buy-and-hold strategy of an investor who has made annual deposits to an account for each of the last five years?

A Geometric mean return.

B Arithmetic mean return.

C Money-weighted return.

5 An investor performs the following transactions on the shares of a firm.

- At t = 0, she purchases a share for $1,000.
- At t = 1, she receives a dividend of $25 and then purchases three additional shares for $1,055 each.
- At t = 2, she receives a total dividend of $100 and then sells the four shares for $1,100 each.

The money-weighted rate of return is *closest* to:

A 4.5%.

B 6.9%.

C 7.3%.

6 A fund receives investments at the beginning of each year and generates returns as shown in the table.

Year of Investment	Assets Under Management at the beginning of each year	Return during Year of Investment
1	$1,000	15%
2	$4,000	14%
3	$45,000	–4%

Which return measure over the three-year period is negative?

A Geometric mean return

B Time-weighted rate of return

C Money-weighted rate of return

7 At the beginning of Year 1, a fund has $10 million under management; it earns a return of 14% for the year. The fund attracts another $100 million at the start of Year 2 and earns a return of 8% for that year. The money-weighted rate of return is *most likely*:

A less than the time-weighted rate of return.

B the same as the time-weighted rate of return.

C greater than the time-weighted rate of return.

8 An investor evaluating the returns of three recently formed exchange-traded funds gathers the following information:

ETF	Time Since Inception	Return Since Inception (%)
1	146 days	4.61
2	5 weeks	1.10
3	15 months	14.35

The ETF with the highest annualized rate of return is:

A ETF 1.

B ETF 2.

C ETF 3.

9 With respect to capital market theory, which of the following asset characteristics is *least likely* to impact the variance of an investor's equally weighted portfolio?

A Return on the asset.

B Standard deviation of the asset.

C Covariances of the asset with the other assets in the portfolio.

10 A portfolio manager creates the following portfolio:

Security	Security Weight (%)	Expected Standard Deviation (%)
1	30	20
2	70	12

If the correlation of returns between the two securities is 0.40, the expected standard deviation of the portfolio is *closest* to:

A 10.7%.

B 11.3%.

C 12.1%.

11 A portfolio manager creates the following portfolio:

Security	Security Weight (%)	Expected Standard Deviation (%)
1	30	20
2	70	12

If the covariance of returns between the two securities is –0.0240, the expected standard deviation of the portfolio is *closest* to:

A 2.4%.

B 7.5%.

C 9.2%.

The following information relates to Questions 12–13

A portfolio manager creates the following portfolio:

Security	Security Weight (%)	Expected Standard Deviation (%)
1	30	20
2	70	12

12 If the standard deviation of the portfolio is 14.40%, the correlation between the two securities is equal to:

A –1.0.

B 0.0.

C 1.0.

13 If the standard deviation of the portfolio is 14.40%, the covariance between the two securities is equal to:

A 0.0006.

B 0.0240.

C 1.0000.

The following information relates to Questions 14–17

An analyst observes the following historic geometric returns:

Asset Class	Geometric Return (%)
Equities	8.0
Corporate Bonds	6.5
Treasury bills	2.5
Inflation	2.1

14 The real rate of return for equities is *closest* to:

A 5.4%.

B 5.8%.

C 5.9%.

15 The real rate of return for corporate bonds is *closest* to:

A 4.3%.

B 4.4%.

C 4.5%.

16 The risk premium for equities is *closest* to:

A 5.4%.

B 5.5%.

C 5.6%.

17 The risk premium for corporate bonds is *closest* to:

A 3.5%.

B 3.9%.

C 4.0%.

---

18 With respect to trading costs, liquidity is *least likely* to impact the:

A stock price.

B bid–ask spreads.

C brokerage commissions.

19 Evidence of risk aversion is *best* illustrated by a risk–return relationship that is:

A negative.

B neutral.

C positive.

20 With respect to risk-averse investors, a risk-free asset will generate a numerical utility that is:

A the same for all individuals.

B positive for risk-averse investors.

C equal to zero for risk seeking investors.

21 With respect to utility theory, the most risk-averse investor will have an indifference curve with the:

A most convexity.

B smallest intercept value.

C greatest slope coefficient.

22 With respect to an investor's utility function expressed as: $U = E(r) - \frac{1}{2}A\sigma^2$, which of the following values for the measure for risk aversion has the *least* amount of risk aversion?

A −4.

B 0.

C 4.

The following information relates to Questions 23–26

A financial planner has created the following data to illustrate the application of utility theory to portfolio selection:

Investment	Expected Return (%)	Expected Standard Deviation (%)
1	18	2
2	19	8
3	20	15
4	18	30

23 A risk-neutral investor is *most likely* to choose:

A Investment 1.

B Investment 2.

C Investment 3.

24 If an investor's utility function is expressed as $U = E(r) - \frac{1}{2}A\sigma^2$ and the measure for risk aversion has a value of –2, the risk-seeking investor is *most likely* to choose:

A Investment 2.

B Investment 3.

C Investment 4.

25 If an investor's utility function is expressed as $U = E(r) - \frac{1}{2}A\sigma^2$ and the measure for risk aversion has a value of 2, the risk-averse investor is *most likely* to choose:

A Investment 1.

B Investment 2.

C Investment 3.

26 If an investor's utility function is expressed as $U = E(r) - \frac{1}{2}A\sigma^2$ and the measure for risk aversion has a value of 4, the risk-averse investor is *most likely* to choose:

A Investment 1.

B Investment 2.

C Investment 3.

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27 With respect to the mean–variance portfolio theory, the capital allocation line, CAL, is the combination of the risk-free asset and a portfolio of all:

A risky assets.

B equity securities.

C feasible investments.

28 Two individual investors with different levels of risk aversion will have optimal portfolios that are:

A below the capital allocation line.

B on the capital allocation line.

C above the capital allocation line.

The following information relates to Questions 29–31

A portfolio manager creates the following portfolio:

Security	Expected Annual Return (%)	Expected Standard Deviation (%)
1	16	20
2	12	20

29 If the portfolio of the two securities has an expected return of 15%, the proportion invested in Security 1 is:

A 25%.

B 50%.

C 75%.

30 If the correlation of returns between the two securities is –0.15, the expected standard deviation of an equal-weighted portfolio is *closest* to:

A 13.04%.

B 13.60%.

C 13.87%.

31 If the two securities are uncorrelated, the expected standard deviation of an equal-weighted portfolio is *closest* to:

A 14.00%.

B 14.14%.

C 20.00%.

---

32 As the number of assets in an equally-weighted portfolio increases, the contribution of each individual asset's variance to the volatility of the portfolio:

A increases.

B decreases.

C remains the same.

33 With respect to an equally-weighted portfolio made up of a large number of assets, which of the following contributes the *most* to the volatility of the portfolio?

A Average variance of the individual assets.

B Standard deviation of the individual assets.

C Average covariance between all pairs of assets.

34 The correlation between assets in a two-asset portfolio increases during a market decline. If there is no change in the proportion of each asset held in the portfolio or the expected standard deviation of the individual assets, the volatility of the portfolio is *most likely* to:

A increase.

B decrease.

C remain the same.

The following information relates to Questions 35–37

An analyst has made the following return projections for each of three possible outcomes with an equal likelihood of occurrence:

Asset	Outcome 1 (%)	Outcome 2 (%)	Outcome 3 (%)	Expected Return (%)
1	12	0	6	6
2	12	6	0	6
3	0	6	12	6

35 Which pair of assets is perfectly negatively correlated?

A Asset 1 and Asset 2.

B Asset 1 and Asset 3.

C Asset 2 and Asset 3.

36 If the analyst constructs two-asset portfolios that are equally-weighted, which pair of assets has the *lowest* expected standard deviation?

A Asset 1 and Asset 2.

B Asset 1 and Asset 3.

C Asset 2 and Asset 3.

37 If the analyst constructs two-asset portfolios that are equally weighted, which pair of assets provides the *least* amount of risk reduction?

A Asset 1 and Asset 2.

B Asset 1 and Asset 3.

C Asset 2 and Asset 3.

---

38 Which of the following statements is *least* accurate? The efficient frontier is the set of all attainable risky assets with the:

A highest expected return for a given level of risk.

B lowest amount of risk for a given level of return.

C highest expected return relative to the risk-free rate.

39 The portfolio on the minimum-variance frontier with the lowest standard deviation is:

A unattainable.

B the optimal risky portfolio.

C the global minimum-variance portfolio.

40 The set of portfolios on the minimum-variance frontier that dominates all sets of portfolios below the global minimum-variance portfolio is the:

A capital allocation line.

B Markowitz efficient frontier.

C set of optimal risky portfolios.

41 The dominant capital allocation line is the combination of the risk-free asset and the:

A optimal risky portfolio.

B levered portfolio of risky assets.

C global minimum-variance portfolio.

42 Compared to the efficient frontier of risky assets, the dominant capital allocation line has higher rates of return for levels of risk greater than the optimal risky portfolio because of the investor's ability to:

A lend at the risk-free rate.

B borrow at the risk-free rate.

C purchase the risk-free asset.

43 With respect to the mean–variance theory, the optimal portfolio is determined by each individual investor's:

A risk-free rate.

B borrowing rate.

C risk preference.

SOLUTIONS

1 C is correct. −10.1% is the holding period return, which is calculated as: (3,050 − 3,450 + 51.55)/3,450, which is comprised of a dividend yield of 1.49% = 51.55/(3,450) and a capital loss yield of −11.59% = −400/(3,450).

2 B is correct. [(1 + 0.14)(1 − 0.10)(1 − 0.02)] − 1 = 0.0055 = 0.55%.

3 A is correct. $[(1 + 0.22)(1 - 0.25)(1 + 0.11)]^{(1/3)} - 1 = 1.0157^{(1/3)} - 1 = 0.0052 = 0.52\%$

4 A is correct. The geometric mean return compounds the returns instead of the amount invested.

5 B is correct. Computation of the money-weighted return, *r*, requires finding the discount rate that sums the present value of cash flows to zero.

The first step is to group net cash flows by time. For this example, we have −$1,000 for the $t = 0$ net cash flow, −$3,140 = −$3,165 + $25 for the $t = 1$ net cash flow, and $4,500 = $4,400 + $100 for the $t = 2$ net cash flow

Solving for *r*,

$$CF_0 = -1{,}000$$
$$CF_1 = -3{,}140$$
$$CF_2 = +4{,}500$$
$$\frac{CF_0}{(1+\text{IRR})^0} + \frac{CF_1}{(1+\text{IRR})^1} + \frac{CF_2}{(1+\text{IRR})^2}$$
$$= \frac{-1{,}000}{1} + \frac{-3{,}140}{(1+\text{IRR})^1} + \frac{4{,}500}{(1+\text{IRR})^2} = 0$$

results in a value of $r = 6.91\%$

6 C is correct. The money-weighted rate of return considers both the timing and amounts of investments into the fund. To calculate the money-weighted rate of return, tabulate the annual returns and investment amounts to determine the cash flows

Year	1	2	3
Balance from previous year	0	$1,150	$4,560
New investment	$1,000	$2,850	$40,440
Net balance at the beginning of year	$1,000	$4,000	$45,000
Investment return for the year	15%	14%	−4%
Investment gain (loss)	$150	$560	−$1,800
Balance at the end of year	$1,150	$4,560	$43,200

$CF_0 = -\$1{,}000$, $CF_1 = -\$2{,}850$, $CF_2 = -\$40{,}440$, $CF_3 = +\$43{,}200$

Each cash inflow or outflow occurs at the end of each year. Thus, CF_0 refers to the cash flow at the end of Year 0 or beginning of Year 1, and CF_3 refers to the cash flow at end of Year 3 or beginning of Year 4. Because cash flows are being discounted to the present—that is, end of Year 0 or beginning of Year 1—the period of discounting CF_0 is zero whereas the period of discounting for CF_3 is 3 years.

Solving for *r*,

$$CF_0 = -1{,}000$$
$$CF_1 = -2{,}850$$
$$CF_2 = -40{,}440$$
$$CF_3 = +43{,}200$$
$$\frac{CF_0}{(1+\text{IRR})^0} + \frac{CF_1}{(1+\text{IRR})^1} + \frac{CF_2}{(1+\text{IRR})^2} + \frac{CF_3}{(1+IRR)^3}$$
$$= \frac{-1{,}000}{1} + \frac{-2{,}850}{(1+\text{IRR})^1} + \frac{-40{,}440}{(1+\text{IRR})^2} + \frac{43{,}200}{(1+\text{IRR})^3} = 0$$

results in a value of $r = -2.22\%$

Note that B is incorrect because the time-weighted rate of return (TWR) of the fund is the same as the geometric mean return of the fund and is thus positive:

$$\text{TWR} = \sqrt[3]{(1.15)(1.14)(0.96)} - 1 = 7.97\%$$

7 A is correct. Computation of the money-weighted return, *r*, requires finding the discount rate that sums the present value of cash flows to zero. Because most of the investment came during Year 2, the measure will be biased toward the performance of Year 2. The cash flows are as follows:

$$CF_0 = -10$$
$$CF_1 = -100$$
$$CF_2 = +120.31$$

The terminal value is determined by summing the investment returns for each period [$(10 \times 1.14 \times 1.08) + (100 \times 1.08)$]

$$\frac{CF_0}{(1+\text{IRR})^0} + \frac{CF_1}{(1+\text{IRR})^1} + \frac{CF_2}{(1+\text{IRR})^2}$$
$$= \frac{-10}{1} + \frac{-100}{(1+\text{IRR})^1} + \frac{120.31}{(1+\text{IRR})^2}$$

results in a value of $r = 8.53\%$

The time-weighted return of the fund is $= \sqrt[2]{(1.14)(1.08)} - 1 = 10.96\%$.

8 B is correct. The annualized rate of return for ETF 2 is $12.05\% = (1.0110^{52/5}) - 1$, which is greater than the annualized rate of ETF 1, $11.93\% = (1.0461^{365/146}) - 1$, and ETF 3, $11.32\% = (1.1435^{12/15}) - 1$. Despite having the lowest value for the periodic rate, ETF 2 has the highest annualized rate of return because of the reinvestment rate assumption and the compounding of the periodic rate.

9 A is correct. The asset's returns are not used to calculate the portfolio's variance [only the assets' weights, standard deviations (or variances), and covariances (or correlations) are used].

10 C is correct.

$$\sigma_{port} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2}$$
$$= \sqrt{(0.3)^2(20\%)^2 + (0.7)^2(12\%)^2 + 2(0.3)(0.7)(0.40)(20\%)(12\%)}$$
$$= (0.3600\% + 0.7056\% + 0.4032\%)^{0.5} = (1.4688\%)^{0.5} = 12.11\%$$

11 A is correct.

$$\begin{aligned}\sigma_{port} &= \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2Cov(R_1R_2)} \\ &= \sqrt{(0.3)^2(20\%)^2 + (0.7)^2(12\%)^2 + 2(0.3)(0.7)(-0.0240)} \\ &= (0.3600\% + 0.7056\% - 1.008\%)^{0.5} = (0.0576\%)^{0.5} = 2.40\%\end{aligned}$$

12 C is correct. A portfolio standard deviation of 14.40% is the weighted average, which is possible only if the correlation between the securities is equal to 1.0.

13 B is correct. A portfolio standard deviation of 14.40% is the weighted average, which is possible only if the correlation between the securities is equal to 1.0. If the correlation coefficient is equal to 1.0, then the covariance must equal 0.0240, calculated as: $Cov(R_1,R_2) = \rho_{12}\sigma_1\sigma_2 = (1.0)(20\%)(12\%) = 2.40\% = 0.0240$.

14 B is correct. $(1 + 0.080)/(1 + 0.0210) - 1 = 5.8\%$

15 A is correct. $(1 + 0.065)/(1 + 0.0210) - 1 = 4.3\%$

16 A is correct. $(1 + 0.080)/(1 + 0.0250) - 1 = 5.4\%$

17 B is correct. $(1 + 0.0650)/(1 + 0.0250) - 1 = 3.9\%$

18 C is correct. Brokerage commissions are negotiated with the brokerage firm. A security's liquidity impacts the operational efficiency of trading costs. Specifically, liquidity impacts the bid–ask spread and can impact the stock price (if the ability to sell the stock is impaired by the uncertainty associated with being able to sell the stock).

19 C is correct. Historical data over long periods of time indicate that there exists a positive risk–return relationship, which is a reflection of an investor's risk aversion.

20 A is correct. A risk-free asset has a variance of zero and is not dependent on whether the investor is risk neutral, risk seeking or risk averse. That is, given that the utility function of an investment is expressed as $U = E(r) - \frac{1}{2}A\sigma^2$, where A is the measure of risk aversion, then the sign of A is irrelevant if the variance is zero (like that of a risk-free asset).

21 C is correct. The most risk-averse investor has the indifference curve with the greatest slope.

22 A is correct. A negative value in the given utility function indicates that the investor is a risk seeker.

23 C is correct. Investment 3 has the highest rate of return. Risk is irrelevant to a risk-neutral investor, who would have a measure of risk aversion equal to 0. Given the utility function, the risk-neutral investor would obtain the greatest amount of utility from Investment 3.

Investment	Expected Return (%)	Expected Standard Deviation (%)	Utility $A = 0$
1	18	2	0.1800
2	19	8	0.1900
3	20	15	0.2000
4	18	30	0.1800

24 C is correct. Investment 4 provides the highest utility value (0.2700) for a risk-seeking investor, who has a measure of risk aversion equal to –2.

Investment	Expected Return (%)	Expected Standard Deviation (%)	Utility $A = -2$
1	18	2	0.1804
2	19	8	0.1964
3	20	15	0.2225
4	18	30	0.2700

25 B is correct. Investment 2 provides the highest utility value (0.1836) for a risk-averse investor who has a measure of risk aversion equal to 2.

Investment	Expected Return (%)	Expected Standard Deviation (%)	Utility $A = 2$
1	18	2	0.1796
2	19	8	0.1836
3	20	15	0.1775
4	18	30	0.0900

26 A is correct. Investment 1 provides the highest utility value (0.1792) for a risk-averse investor who has a measure of risk aversion equal to 4.

Investment	Expected Return (%)	Expected Standard Deviation (%)	Utility $A = 4$
1	18	2	0.1792
2	19	8	0.1772
3	20	15	0.1550
4	18	30	0.0000

27 A is correct. The CAL is the combination of the risk-free asset with zero risk and the portfolio of all risky assets that provides for the set of feasible investments. Allowing for borrowing at the risk-free rate and investing in the portfolio of all risky assets provides for attainable portfolios that dominate risky assets below the CAL.

28 B is correct. The CAL represents the set of all feasible investments. Each investor's indifference curve determines the optimal combination of the risk-free asset and the portfolio of all risky assets, which must lie on the CAL.

29 C is correct.

$$R_p = w_1 \times R_1 + (1 - w_1) \times R_2$$
$$R_p = w_1 \times 16\% + (1 - w_1) \times 12\%$$
$$15\% = 0.75(16\%) + 0.25(12\%)$$

30 A is correct.

$$\sigma_{port} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2}$$
$$= \sqrt{(0.5)^2(20\%)^2 + (0.5)^2(20\%)^2 + 2(0.5)(0.5)(-0.15)(20\%)(20\%)}$$
$$= (1.0000\% + 1.0000\% - 0.3000\%)^{0.5} = (1.7000\%)^{0.5} = 13.04\%$$

31 B is correct.

$$\begin{aligned}\sigma_{port} &= \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2} \\ &= \sqrt{(0.5)^2(20\%)^2 + (0.5)^2\left(20\%^2\right) + 2(0.5)(0.5)(0.00)(20\%)(20\%)} \\ &= (1.0000\% + 1.0000\% + 0.0000\%)^{0.5} = (2.0000\%)^{0.5} = 14.14\%\end{aligned}$$

32 B is correct. The contribution of each individual asset's variance (or standard deviation) to the portfolio's volatility decreases as the number of assets in the equally weighted portfolio increases. The contribution of the co-movement measures between the assets increases (i.e., covariance and correlation) as the number of assets in the equally weighted portfolio increases. The following equation for the variance of an equally weighted portfolio illustrates these points: $\sigma_p^2 = \frac{\bar{\sigma}^2}{N} + \frac{N-1}{N}\overline{COV} = \frac{\bar{\sigma}^2}{N} + \frac{N-1}{N}\bar{\rho}\bar{\sigma}^2$.

33 C is correct. The co-movement measures between the assets increases (i.e., covariance and correlation) as the number of assets in the equally weighted portfolio increases. The contribution of each individual asset's variance (or standard deviation) to the portfolio's volatility decreases as the number of assets in the equally weighted portfolio increases. The following equation for the variance of an equally weighted portfolio illustrates these points:

$$\sigma_p^2 = \frac{\bar{\sigma}^2}{N} + \frac{N-1}{N}\overline{COV} = \frac{\bar{\sigma}^2}{N} + \frac{N-1}{N}\bar{\rho}\bar{\sigma}^2$$

34 A is correct. Higher correlations will produce less diversification benefits provided that the other components of the portfolio standard deviation do not change (i.e., the weights and standard deviations of the individual assets).

35 C is correct. Asset 2 and Asset 3 have returns that are the same for Outcome 2, but the exact opposite returns for Outcome 1 and Outcome 3; therefore, because they move in opposite directions at the same magnitude, they are perfectly negatively correlated.

36 C is correct. An equally weighted portfolio of Asset 2 and Asset 3 will have the lowest portfolio standard deviation, because for each outcome, the portfolio has the same expected return (they are perfectly negatively correlated).

37 A is correct. An equally weighted portfolio of Asset 1 and Asset 2 has the highest level of volatility of the three pairs. All three pairs have the same expected return; however, the portfolio of Asset 1 and Asset 2 provides the least amount of risk reduction.

38 C is correct. The efficient frontier does not account for the risk-free rate. The efficient frontier is the set of all attainable risky assets with the highest expected return for a given level of risk or the lowest amount of risk for a given level of return.

39 C is correct. The global minimum-variance portfolio is the portfolio on the minimum-variance frontier with the lowest standard deviation. Although the portfolio is attainable, when the risk-free asset is considered, the global minimum-variance portfolio is not the optimal risky portfolio.

40 B is correct. The Markowitz efficient frontier has higher rates of return for a given level of risk. With respect to the minimum-variance portfolio, the Markowitz efficient frontier is the set of portfolios above the global minimum-variance portfolio that dominates the portfolios below the global minimum-variance portfolio.

41 A is correct. The use of leverage and the combination of a risk-free asset and the optimal risky asset will dominate the efficient frontier of risky assets (the Markowitz efficient frontier).

42 B is correct. The CAL dominates the efficient frontier at all points except for the optimal risky portfolio. The ability of the investor to purchase additional amounts of the optimal risky portfolio by borrowing (i.e., buying on margin) at the risk-free rate makes higher rates of return for levels of risk greater than the optimal risky asset possible.

43 C is correct. Each individual investor's optimal mix of the risk-free asset and the optimal risky asset is determined by the investor's risk preference.

PRACTICE PROBLEMS

1 The line depicting the total risk and expected return of portfolio combinations of a risk-free asset and any risky asset is the:

A security market line.

B capital allocation line.

C security characteristic line.

2 The portfolio of a risk-free asset and a risky asset has a better risk-return tradeoff than investing in only one asset type because the correlation between the risk-free asset and the risky asset is equal to:

A –1.0.

B 0.0.

C 1.0.

3 With respect to capital market theory, an investor's optimal portfolio is the combination of a risk-free asset and a risky asset with the highest:

A expected return.

B indifference curve.

C capital allocation line slope.

4 Highly risk-averse investors will *most likely* invest the majority of their wealth in:

A risky assets.

B risk-free assets.

C the optimal risky portfolio.

5 The capital market line (CML) is the graph of the risk and return of portfolio combinations consisting of the risk-free asset and:

A any risky portfolio.

B the market portfolio.

C the leveraged portfolio.

6 Which of the following statements *most accurately* defines the market portfolio in capital market theory? The market portfolio consists of all:

A risky assets.

B tradable assets.

C investable assets.

7 With respect to capital market theory, the optimal risky portfolio:

A is the market portfolio.

B has the highest expected return.

C has the lowest expected variance.

8 Relative to portfolios on the CML, any portfolio that plots above the CML is considered:

A inferior.

B inefficient.

C unachievable.

9 A portfolio on the capital market line with returns greater than the returns on the market portfolio represents a(n):

A lending portfolio.

B borrowing portfolio.

C unachievable portfolio.

10 With respect to the capital market line, a portfolio on the CML with returns less than the returns on the market portfolio represents a(n):

A lending portfolio.

B borrowing portfolio.

C unachievable portfolio.

11 Which of the following types of risk is *most likely* avoided by forming a diversified portfolio?

A Total risk.

B Systematic risk.

C Nonsystematic risk.

12 Which of the following events is *most likely* an example of nonsystematic risk?

A A decline in interest rates.

B The resignation of chief executive officer.

C An increase in the value of the US dollar.

13 With respect to the pricing of risk in capital market theory, which of the following statements is *most accurate*?

A All risk is priced.

B Systematic risk is priced.

C Nonsystematic risk is priced.

14 The sum of an asset's systematic variance and its nonsystematic variance of returns is equal to the asset's:

A beta.

B total risk.

C total variance.

15 With respect to return-generating models, the intercept term of the market model is the asset's estimated:

A beta.

B alpha.

C variance.

16 With respect to return-generating models, the slope term of the market model is an estimate of the asset's:

A total risk.

B systematic risk.

C nonsystematic risk.

17 With respect to return-generating models, which of the following statements is *most accurate*? Return-generating models are used to directly estimate the:

A expected return of a security.

B weights of securities in a portfolio.

C parameters of the capital market line.

The following information relates to Questions 18–20

An analyst gathers the following information:

Security	Expected Annual Return (%)	Expected Standard Deviation (%)	Correlation between Security and the Market
Security 1	11	25	0.6
Security 2	11	20	0.7
Security 3	14	20	0.8
Market	10	15	1.0

18 Which security has the *highest* total risk?

A Security 1.

B Security 2.

C Security 3.

19 Which security has the *highest* beta measure?

A Security 1.

B Security 2.

C Security 3.

20 Which security has the *least* amount of market risk?

A Security 1.

B Security 2.

C Security 3.

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21 With respect to capital market theory, the average beta of all assets in the market is:

A less than 1.0.

B equal to 1.0.

C greater than 1.0.

22 The slope of the security characteristic line is an asset's:

A beta.

B excess return.

C risk premium.

23 The graph of the capital asset pricing model is the:

A capital market line.

B security market line.

C security characteristic line.

24 With respect to capital market theory, correctly priced individual assets can be plotted on the:

A capital market line.

B security market line.

C capital allocation line.

25 With respect to the capital asset pricing model, the primary determinant of expected return of an individual asset is the:

A asset's beta.

B market risk premium.

C asset's standard deviation.

26 With respect to the capital asset pricing model, which of the following values of beta for an asset is *most likely* to have an expected return for the asset that is less than the risk-free rate?

A −0.5

B 0.0

C 0.5

27 With respect to the capital asset pricing model, the market risk premium is:

A less than the excess market return.

B equal to the excess market return.

C greater than the excess market return.

The following information relates to Questions 28–31

An analyst gathers the following information:

Security	Expected Standard Deviation (%)	Beta
Security 1	25	1.50
Security 2	15	1.40
Security 3	20	1.60

28 With respect to the capital asset pricing model, if the expected market risk premium is 6% and the risk-free rate is 3%, the expected return for Security 1 is *closest* to:

A 9.0%.

B 12.0%.

C 13.5%.

29 With respect to the capital asset pricing model, if expected return for Security 2 is equal to 11.4% and the risk-free rate is 3%, the expected return for the market is *closest* to:

A 8.4%.

B 9.0%.

C 10.3%.

30 With respect to the capital asset pricing model, if the expected market risk premium is 6% the security with the *highest* expected return is:

A Security 1.

B Security 2.

C Security 3.

31 With respect to the capital asset pricing model, a decline in the expected market return will have the *greatest* impact on the expected return of:

A Security 1.
B Security 2.
C Security 3.

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32 Three equity fund managers have performance records summarized in the following table:

	Mean Annual Return (%)	Standard Deviation of Return (%)
Manager 1	14.38	10.53
Manager 2	9.25	6.35
Manager 3	13.10	8.23

Given a risk-free rate of return of 2.60%, which manager performed best based on the Sharpe ratio?

A Manager 1
B Manager 2
C Manager 3

33 Which of the following performance measures is consistent with the CAPM?

A *M*-squared.
B Sharpe ratio.
C Jensen's alpha.

34 Which of the following performance measures does *not* require the measure to be compared to another value?

A Sharpe ratio.
B Treynor ratio.
C Jensen's alpha.

35 Which of the following performance measures is *most* appropriate for an investor who is *not* fully diversified?

A *M*-squared.
B Treynor ratio.
C Jensen's alpha.

36 Analysts who have estimated returns of an asset to be greater than the expected returns generated by the capital asset pricing model should consider the asset to be:

A overvalued.
B undervalued.
C properly valued.

37 With respect to capital market theory, which of the following statements *best* describes the effect of the homogeneity assumption? Because all investors have the same economic expectations of future cash flows for all assets, investors will invest in:

A the same optimal risky portfolio.
B the Standard and Poor's 500 Index.
C assets with the same amount of risk.

38 With respect to capital market theory, which of the following assumptions allows for the existence of the market portfolio? All investors:

A are price takers.

B have homogeneous expectations.

C plan for the same, single holding period.

39 The intercept of the best fit line formed by plotting the excess returns of a manager's portfolio on the excess returns of the market is *best* described as Jensen's:

A beta.

B ratio.

C alpha.

40 Portfolio managers who are maximizing risk-adjusted returns will seek to invest *more* in securities with:

A lower values of Jensen's alpha.

B values of Jensen's alpha equal to 0.

C higher values of Jensen's alpha.

41 Portfolio managers, who are maximizing risk-adjusted returns, will seek to invest *less* in securities with:

A lower values for nonsystematic variance.

B values of nonsystematic variance equal to 0.

C higher values for nonsystematic variance.

SOLUTIONS

1 B is correct. A capital allocation line (CAL) plots the expected return and total risk of combinations of the risk-free asset and a risky asset (or a portfolio of risky assets).

2 B is correct. A portfolio of the risk-free asset and a risky asset or a portfolio of risky assets can result in a better risk-return tradeoff than an investment in only one type of an asset, because the risk-free asset has zero correlation with the risky asset.

3 B is correct. Investors will have different optimal portfolios depending on their indifference curves. The optimal portfolio for each investor is the one with highest utility; that is, where the CAL is tangent to the individual investor's highest possible indifference curve.

4 B is correct. Although the optimal risky portfolio is the market portfolio, highly risk-averse investors choose to invest most of their wealth in the risk-free asset.

5 B is correct. Although the capital allocation line includes all possible combinations of the risk-free asset and any risky portfolio, the capital market line is a special case of the capital allocation line, which uses the market portfolio as the optimal risky portfolio.

6 A is correct. The market includes all risky assets, or anything that has value; however, not all assets are tradable, and not all tradable assets are investable.

7 A is correct. The optimal risky portfolio is the market portfolio. Capital market theory assumes that investors have homogeneous expectations, which means that all investors analyze securities in the same way and are rational. That is, investors use the same probability distributions, use the same inputs for future cash flows, and arrive at the same valuations. Because their valuations of all assets are identical, all investors will invest in the same optimal risky portfolio (i.e., the market portfolio).

8 C is correct. Theoretically, any point above the CML is not achievable and any point below the CML is dominated by and inferior to any point on the CML.

9 B is correct. As one moves further to the right of point M on the capital market line, an increasing amount of borrowed money is being invested in the market portfolio. This means that there is negative investment in the risk-free asset, which is referred to as a leveraged position in the risky portfolio.

10 A is correct. The combinations of the risk-free asset and the market portfolio on the CML where returns are less than the returns on the market portfolio are termed 'lending' portfolios.

11 C is correct. Investors are capable of avoiding nonsystematic risk by forming a portfolio of assets that are not highly correlated with one another, thereby reducing total risk and being exposed only to systematic risk.

12 B is correct. Nonsystematic risk is specific to a firm, whereas systematic risk affects the entire economy.

13 B is correct. Only systematic risk is priced. Investors do not receive any return for accepting nonsystematic or diversifiable risk.

14 C is correct. The sum of systematic variance and nonsystematic variance equals the total variance of the asset. References to total risk as the sum of systematic risk and nonsystematic risk refer to variance, not to risk.

15 B is correct. In the market model, $R_i = \alpha_i + \beta_i R_m + e_i$, the intercept, α_i, and slope coefficient, β_i, are estimated using historical security and market returns.

16 B is correct. In the market model, $R_i = \alpha_i + \beta_i R_m + e_i$, the slope coefficient, β_i, is an estimate of the asset's systematic or market risk.

17 A is correct. In the market model, $R_i = \alpha_i + \beta_i R_m + e_i$, the intercept, α_i, and slope coefficient, β_i, are estimated using historical security and market returns. These parameter estimates then are used to predict firm-specific returns that a security may earn in a future period.

18 A is correct. Security 1 has the highest total risk = 0.25 compared to Security 2 and Security 3 with a total risk of 0.20.

19 C is correct. Security 3 has the highest beta value; $1.07 = \dfrac{\rho_{3,m}\sigma_3}{\sigma_m} = \dfrac{(0.80)(20\%)}{15\%}$ compared to Security 1 and Security 2 with beta values of 1.00 and 0.93, respectively.

20 B is correct. Security 2 has the lowest beta value; $0.93 = \dfrac{\rho_{2,m}\sigma_2}{\sigma_m} = \dfrac{(0.70)(20\%)}{15\%}$ compared to Security 1 and 3 with beta values of 1.00 and 1.07, respectively.

21 B is correct. The average beta of all assets in the market, by definition, is equal to 1.0.

22 A is correct. The security characteristic line is a plot of the excess return of the security on the excess return of the market. In such a graph, Jensen's alpha is the intercept and the beta is the slope.

23 B is correct. The security market line (SML) is a graphical representation of the capital asset pricing model, with beta risk on the x-axis and expected return on the y-axis.

24 B is correct. The security market line applies to any security, efficient or not. The CAL and the CML use the total risk of the asset (or portfolio of assets) rather than its systematic risk, which is the only risk that is priced.

25 A is correct. The CAPM shows that the primary determinant of expected return for an individual asset is its beta, or how well the asset correlates with the market.

26 A is correct. If an asset's beta is negative, the required return will be less than the risk-free rate in the CAPM. When combined with a positive market return, the asset reduces the risk of the overall portfolio, which makes the asset very valuable. Insurance is an example of a negative beta asset.

27 B is correct. In the CAPM, the market risk premium is the difference between the return on the market and the risk-free rate, which is the same as the return in excess of the market return.

28 B is correct. The expected return of Security 1, using the CAPM, is 12.0% = 3% + 1.5(6%); $E(R_i) = R_f + \beta_i[E(R_m) - R_f]$.

29 B is correct. The expected risk premium for Security 2 is 8.4%, (11.4% – 3%), indicates that the expected market risk premium is 6%; therefore, since the risk-free rate is 3% the expected rate of return for the market is 9%. That is, using the CAPM, $E(R_i) = R_f + \beta_i[E(R_m) - R_f]$, 11.4% = 3% + 1.4(X%), where X% = (11.4% – 3%)/1.4 = 6.0% = market risk premium.

30 C is correct. Security 3 has the highest beta; thus, regardless of the value for the risk-free rate, Security 3 will have the highest expected return:

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f]$$

31 C is correct. Security 3 has the highest beta; thus, regardless of the risk-free rate the expected return of Security 3 will be most sensitive to a change in the expected market return.

32 C is correct. The Sharpe ratio $\left(\widehat{\text{SR}}\right)$ is the mean excess portfolio return per unit of risk, where a higher Sharpe ratio indicates better performance:

$$\widehat{SR}_1 = \frac{\bar{R}_p - \bar{R}_f}{\hat{\sigma}_p} = \frac{14.38 - 2.60}{10.53} = 1.12$$

$$\widehat{SR}_2 = \frac{\bar{R}_p - \bar{R}_f}{\hat{\sigma}_p} = \frac{9.25 - 2.60}{6.35} = 1.05$$

$$\widehat{SR}_3 = \frac{\bar{R}_p - \bar{R}_f}{\hat{\sigma}_p} = \frac{13.10 - 2.60}{8.23} = 1.28$$

33 C is correct. Jensen's alpha adjusts for systematic risk, and *M*-squared and the Sharpe Ratio adjust for total risk.

34 C is correct. The sign of Jensen's alpha indicates whether or not the portfolio has outperformed the market. If alpha is positive, the portfolio has outperformed the market; if alpha is negative, the portfolio has underperformed the market.

35 A is the correct. *M*-squared adjusts for risk using standard deviation (i.e., total risk).

36 B is correct. If the estimated return of an asset is above the SML (the expected return), the asset has a lower level of risk relative to the amount of expected return and would be a good choice for investment (i.e., undervalued).

37 A is correct. The homogeneity assumption refers to all investors having the same economic expectation of future cash flows. If all investors have the same expectations, then all investors should invest in the same optimal risky portfolio, therefore implying the existence of only one optimal portfolio (i.e., the market portfolio).

38 B is correct. The homogeneous expectations assumption means that all investors analyze securities in the same way and are rational. That is, they use the same probability distributions, use the same inputs for future cash flows, and arrive at the same valuations. Because their valuation of all assets is identical, they will generate the same optimal risky portfolio, which is the market portfolio.

39 C is correct. This is because of the plot of the excess return of the security on the excess return of the market. In such a graph, Jensen's alpha is the intercept and the beta is the slope.

40 C is correct. Since managers are concerned with maximizing risk-adjusted returns, securities with a higher value of Jensen's alpha, α_i, should have a higher weight.

41 C is correct. Since managers are concerned with maximizing risk-adjusted returns, securities with greater nonsystematic risk should be given less weight in the portfolio.

PRACTICE PROBLEMS

1 Which of the following is *least* important as a reason for a written investment policy statement (IPS)?

A The IPS may be required by regulation.

B Having a written IPS is part of best practice for a portfolio manager.

C Having a written IPS ensures the client's risk and return objectives can be achieved.

2 Which of the following *best* describes the underlying rationale for a written investment policy statement (IPS)?

A A written IPS communicates a plan for trying to achieve investment success.

B A written IPS provides investment managers with a ready defense against client lawsuits.

C A written IPS allows investment managers to instruct clients about the proper use and purpose of investments.

3 A written investment policy statement (IPS) is *most* likely to succeed if:

A it is created by a software program to assure consistent quality.

B it is a collaborative effort of the client and the portfolio manager.

C it reflects the investment philosophy of the portfolio manager.

4 The section of the investment policy statement (IPS) that provides information about how policy may be executed, including investment constraints, is *best* described as the:

A *Investment Objectives*.

B *Investment Guidelines*.

C *Statement of Duties and Responsibilities*.

5 Which of the following is *least* likely to be placed in the appendices to an investment policy statement (IPS)?

A *Rebalancing Policy*.

B *Strategic Asset Allocation*.

C *Statement of Duties and Responsibilities*.

6 Which of the following typical topics in an investment policy statement (IPS) is *most* closely linked to the client's "distinctive needs"?

A *Procedures*.

B *Investment Guidelines*.

C *Statement of Duties and Responsibilities*.

7 An investment policy statement that includes a return objective of outperforming the FTSE 100 by 120 basis points is *best* characterized as having a(n):

A relative return objective.

B absolute return objective.

C arbitrage-based return objective.

8 Risk assessment questionnaires for investment management clients are *most* useful in measuring:

A value at risk.

B ability to take risk.

C willingness to take risk.

9 Which of the following is *best* characterized as a relative risk objective?

A Value at risk for the fund will not exceed US$3 million.

B The fund will not underperform the DAX by more than 250 basis points.

C The fund will not lose more than €2.5 million in the coming 12-month period.

10 In preparing an investment policy statement, which of the following is *most* difficult to quantify?

A Time horizon.

B Ability to accept risk.

C Willingness to accept risk.

11 After interviewing a client in order to prepare a written investment policy statement (IPS), you have established the following:

- The client has earnings that vary dramatically between £30,000 and £70,000 (pre-tax) depending on weather patterns in Britain.
- In three of the previous five years, the after-tax income of the client has been less than £20,000.
- The client's mother is dependent on her son (the client) for approximately £9,000 per year support.
- The client's own subsistence needs are approximately £12,000 per year.
- The client has more than 10 years' experience trading investments including commodity futures, stock options, and selling stock short.
- The client's responses to a standard risk assessment questionnaire suggest he has above average risk tolerance.

The client is *best* described as having a:

A low ability to take risk, but a high willingness to take risk.

B high ability to take risk, but a low willingness to take risk.

C high ability to take risk and a high willingness to take risk.

12 After interviewing a client in order to prepare a written investment policy statement (IPS), you have established the following:

- The client has earnings that have exceeded €120,000 (pre-tax) each year for the past five years.
- She has no dependents.
- The client's subsistence needs are approximately €45,000 per year.
- The client states that she feels uncomfortable with her lack of understanding of securities markets.
- All of the client's current savings are invested in short-term securities guaranteed by an agency of her national government.
- The client's responses to a standard risk assessment questionnaire suggest she has low risk tolerance.

The client is *best* described as having a:

A low ability to take risk, but a high willingness to take risk.

B high ability to take risk, but a low willingness to take risk.

C high ability to take risk and a high willingness to take risk.

13 A client who is a 34-year old widow with two healthy young children (aged 5 and 7) has asked you to help her form an investment policy statement. She has been employed as an administrative assistant in a bureau of her national government for the previous 12 years. She has two primary financial goals—her retirement and providing for the college education of her children. This client's time horizon is *best* described as being:

A long term.

B short term.

C medium term.

14 The timing of payouts for property and casualty insurers is unpredictable ("lumpy") in comparison with the timing of payouts for life insurance companies. Therefore, in general, property and casualty insurers have:

A lower liquidity needs than life insurance companies.

B greater liquidity needs than life insurance companies.

C a higher return objective than life insurance companies.

15 A client who is a director of a publicly listed corporation is required by law to refrain from trading that company's stock at certain points of the year when disclosure of financial results are pending. In preparing a written investment policy statement (IPS) for this client, this restriction on trading:

A is irrelevant to the IPS.

B should be included in the IPS.

C makes it illegal for the portfolio manager to work with this client.

16 Consider the pairwise correlations of monthly returns of the following asset classes:

	Brazilian Equities	East Asian Equities	European Equities	US Equities
Brazilian equities	1.00	0.70	0.85	0.76
East Asian equities	0.70	1.00	0.91	0.88
European equities	0.85	0.91	1.00	0.90
US equities	0.76	0.88	0.90	1.00

Based solely on the information in the above table, which equity asset class is *most* sharply distinguished from US equities?

A Brazilian equities.

B European equities.

C East Asian equities.

17 Returns on asset classes are *best* described as being a function of:

A the failure of arbitrage.

B exposure to the idiosyncratic risks of those asset classes.

C exposure to sets of systematic factors relevant to those asset classes.

18 In defining asset classes as part of the strategic asset allocation decision, pairwise correlations within asset classes should generally be:

A equal to correlations among asset classes.

B lower than correlations among asset classes.

C higher than correlations among asset classes.

19 Tactical asset allocation is *best* described as:

A attempts to exploit arbitrage possibilities among asset classes.

B the decision to deliberately deviate from the policy portfolio.

C selecting asset classes with the desired exposures to sources of systematic risk in an investment portfolio.

SOLUTIONS

1 C is correct. Depending on circumstances, a written IPS or its equivalent may be required by law or regulation and a written IPS is certainly consistent with best practices. The mere fact that a written IPS is prepared for a client, however, does not *ensure* that risk and return objectives will in fact be achieved.

2 A is correct. A written IPS is best seen as a communication instrument allowing clients and portfolio managers to mutually establish investment objectives and constraints.

3 B is correct. A written IPS, to be successful, must incorporate a full understanding of the client's situation and requirements. As stated in the reading, "The IPS will be developed following a fact finding discussion with the client."

4 B is correct. The major components of an IPS are listed in Section 2.2 of the reading. *Investment Guidelines* are described as the section that provides information about how policy may be executed, including investment constraints. *Statement of Duties and Responsibilities* "detail[s] the duties and responsibilities of the client, the custodian of the client's assets, the investment managers, and so forth." *Investment Objectives* is "a section explaining the client's objectives in investing."

5 C is correct. The major components of an IPS are listed in Section 2.2 of the reading. Strategic Asset Allocation (also known as the policy portfolio) and Rebalancing Policy are often included as appendices to the IPS. The *Statement of Duties and Responsibilities*, however, is an integral part of the IPS and is unlikely to be placed in an appendix.

6 B is correct. According to the reading, "The sections of an IPS that are most closely linked to the client's distinctive needs are those dealing with investment objectives and constraints." *Investment Guidelines* "[provide] information about how policy may be executed, including investment constraints." *Procedures* "[detail] the steps to be taken to keep the IPS current and the procedures to follow to respond to various contingencies." *Statement of Duties and Responsibilities* "detail[s] the duties and responsibilities of the client, the custodian of the client's assets, the investment managers, and so forth."

7 A is correct. Because the return objective specifies a target return *relative to* the FTSE 100 Index, the objective is best described as a relative return objective.

8 C is correct. Risk attitude is a subjective factor and measuring risk attitude is difficult. Oftentimes, investment managers use psychometric questionnaires, such as those developed by Grable and Joo (2004), to assess a client's willingness to take risk.

9 B is correct. The reference to the DAX marks this response as a relative risk objective. Value at risk establishes a minimum value of loss expected during a specified time period at a given level of probability. A statement of maximum allowed absolute loss (€2.5 million) is an absolute risk objective.

10 C is correct. Measuring willingness to take risk (risk tolerance, risk aversion) is an exercise in applied psychology. Instruments attempting to measure risk attitudes exist, but they are clearly less objective than measurements of ability to take risk. Ability to take risk is based on relatively objective traits such as expected income, time horizon, and existing wealth relative to liabilities.

11 A is correct. The volatility of the client's income and the significant support needs for his mother and himself suggest that the client has a low ability to take risk. The client's trading experience and his responses to the risk assessment questionnaire indicate that the client has an above average willingness to take risk.

12 B is correct. On the one hand, the client has a stable, high income and no dependents. On the other hand, she exhibits above average risk aversion. Her ability to take risk is high, but her willingness to take risk is low.

13 A is correct. The client's financial objectives are long term. Her stable employment indicates that her immediate liquidity needs are modest. The children will not go to college until 10 or more years later. Her time horizon is best described as being long term.

14 B is correct. The unpredictable nature of property and casualty (P&C) claims forces P&C insurers to allocate a substantial proportion of their investments into liquid, short maturity assets. This need for liquidity also forces P&C companies to accept investments with relatively low expected returns. Liquidity is of less concern to life insurance companies given the greater predictability of life insurance payouts.

15 B is correct. When a client has a restriction in trading, such as this obligation to refrain from trading, the IPS "should note this constraint so that the portfolio manager does not inadvertently trade the stock on the client's behalf."

16 A is correct. The correlation between US equities and Brazilian equities is 0.76. The correlations between US equities and East Asian equities and the correlation between US equities and European equities both exceed 0.76. Lower correlations indicate a greater degree of separation between asset classes. Therefore, using solely the data given in the table, returns on Brazilian equities are most sharply distinguished from returns on US equities.

17 C is correct. Strategic asset allocation depends on several principles. As stated in the reading, "One principle is that a portfolio's systematic risk accounts for most of its change in value over the long run." A second principle is that, "the returns to groups of like assets… predictably reflect exposures to certain sets of systematic factors." This latter principle establishes that returns on asset classes primarily reflect the systematic risks of the classes.

18 C is correct. As the reading states, "an asset class should contain homogeneous assets… paired correlations of securities would be high within an asset class, but should be lower versus securities in other asset classes."

19 B is correct. Tactical asset allocation allows actual asset allocation to deviate from that of the strategic asset allocation (policy portfolio) of the IPS. Tactical asset allocation attempts to take advantage of temporary dislocations from the market conditions and assumptions that drove the policy portfolio decision.

PRACTICE PROBLEMS

1 Risk management in the case of individuals is *best* described as concerned with:
   A hedging risk exposures.
   B maximizing utility while bearing a tolerable level of risk.
   C maximizing utility while avoiding exposure to undesirable risks.

2 Which of the following may be controlled by an investor?
   A Risk
   B Raw returns
   C Risk-adjusted returns

3 The process of risk management includes:
   A minimizing risk.
   B maximizing returns.
   C defining and measuring risks being taken.

4 Risk governance:
   A aligns risk management activities with the goals of the overall enterprise.
   B defines the qualitative assessment and evaluation of potential sources of risk in an organization.
   C delegates responsibility for risk management to all levels of the organization's hierarchy.

5 The factors a risk management framework should address include all of the following *except*:
   A communications.
   B policies and processes.
   C names of responsible individuals.

6 Which of the following is the correct sequence of events for risk governance and management that focuses on the entire enterprise? Establishing:
   A risk tolerance, then risk budgeting, and then risk exposures.
   B risk exposures, then risk tolerance, and then risk budgeting.
   C risk budgeting, then risk exposures, and then risk tolerance.

7 Which of the following *best* describes activities that are supported by a risk management infrastructure?
   A Risk tolerance, budgeting, and reporting
   B Risk tolerance, measurement, and monitoring
   C Risk identification, measurement, and monitoring

8 Effective risk governance in an enterprise provides guidance on all of the following *except*:
   A unacceptable risks.
   B worst losses that may be tolerated.
   C specific methods to mitigate risk for each subsidiary in the enterprise.

9 A firm's risk management committee would be expected to do all of the following *except*:
   A approving the governing body's proposed risk policies.

B deliberating the governing body's risk policies at the operational level.

C providing top decision-makers with a forum for considering risk management issues.

10 Once an enterprise's risk tolerance is determined, the role of risk management is to:

A analyze risk drivers.

B align risk exposures with risk appetite.

C identify the extent to which the enterprise is willing to fail in meeting its objectives.

11 Which factor should *most* affect a company's ability to tolerate risk?

A A stable market environment

B The beliefs of the individual board members

C The ability to dynamically respond to adverse events

12 Risk budgeting includes all of the following *except*:

A determining the target return.

B quantifying tolerable risk by specific metrics.

C allocating a portfolio by some risk characteristics of the investments.

13 A benefit of risk budgeting is that it:

A considers risk tradeoffs.

B establishes a firm's risk tolerance.

C reduces uncertainty facing the firm.

14 Which of the following risks is *best* described as a financial risk?

A Credit

B Solvency

C Operational

15 Liquidity risk is *most* associated with:

A the probability of default.

B a widening bid–ask spread.

C a poorly functioning market.

16 An example of a non-financial risk is:

A market risk.

B liquidity risk.

C settlement risk.

17 If a company has a one-day 5% Value at Risk of $1 million, this means:

A 5% of the time the firm is expected to lose at least $1 million in one day.

B 95% of the time the firm is expected to lose at least $1 million in one day.

C 5% of the time the firm is expected to lose no more than $1 million in one day.

18 An organization choosing to accept a risk exposure may:

A buy insurance.

B enter into a derivative contract.

C establish a reserve fund to cover losses.

19 The choice of risk-modification method is based on:

A minimizing risk at the lowest cost.

B maximizing returns at the lowest cost.

C weighing costs versus benefits in light of the organization's risk tolerance.

SOLUTIONS

1 B is correct. For individuals, risk management concerns maximizing utility while taking risk consistent with individual's level of risk tolerance.

2 A is correct. Many decision makers focus on return, which is not something that is easily controlled, as opposed to risk, or exposure to risk, which may actually be managed or controlled

3 C is correct. Risks need to be defined and measured so as to be consistent with the organization's chosen level of risk tolerance and target for returns or other outcomes.

4 A is correct. Risk governance is the top-down process that defines risk tolerance, provides risk oversight and guidance to align risk with enterprise goals.

5 C is correct. While risk infrastructure, which a risk management framework must address, refers to the people and systems required to track risk exposures, there is no requirement to actually name the responsible individuals.

6 A is correct. In establishing a risk management system, determining risk tolerance must happen before specific risks can be accepted or reduced. Risk tolerance defines the appetite for risk. Risk budgeting determine how or where the risk is taken and quantifies the tolerable risk by specific metrics. Risk exposures can then be measured and compared against the acceptable risk.

7 C is correct. *Risk infrastructure* refers to the people and systems required to track risk exposures and perform most of the quantitative risk analysis to allow an assessment of the organization's risk profile. The risk management infrastructure identifies, measures, and monitors risks (among other things).

8 C is correct. Risk governance is not about specifying methods to mitigate risk at the business line level. Rather, it is about establishing an appropriate level of risk for the entire enterprise. Specifics of dealing with risk fall under risk management and the risk infrastructure framework.

9 A is correct. The risk management committee is a part of the risk governance structure at the operational level—as such, it does not approve the governing body's policies.

10 B is correct. When risk tolerance has been determined, the risk framework should be geared toward measuring, managing, and complying with the risk tolerance, or aligning risk exposure with risk tolerance. The risk tolerance decision begins by looking at what shortfalls within an organization would cause it to fail to achieve some critical goals and what are the organization's risk drivers.

11 C is correct. If a company has the ability to adapt quickly to adverse events may allow for a higher risk tolerance. There are other factors, such as beliefs of board members and a stable market environment, which may but should not affect risk tolerance.

12 A is correct. Risk budgeting does not include determining the target return. Risk budgeting quantifies and allocates the tolerable risk by specific metrics.

13 A is correct. The process of risk budgeting forces the firm to consider risk tradeoffs. As a result, the firm should choose to invest where the return per unit of risk is the highest.

14 A is correct. A financial risk originates from the financial markets. Credit risk is one of three financial risks identified in the reading: Credit risk is the chance of loss due to an outside party defaulting on an obligation. Solvency risk depends at least in part on factors internal to the organization and operational risk is an *internal* risk arising from the people and processes within the organization.

15 B is correct. Liquidity risk is also called transaction cost risk. When the bid–ask spread widens, purchase and sale transactions become increasingly costly. The risk arises from the uncertainty of the spread.

16 C is correct. Settlement risk is related to default risk, but deals with the timing of payments rather than the risk of default.

17 A is correct. The VaR measure indicates the probability of a loss of at least a certain level in a time period.

18 C is correct. Risk acceptance is similar to self-insurance. An organization choosing to self-insure may set up a reserve fund to cover losses. Buying insurance is a form of risk transfer and using derivatives is a form of risk-shifting, not risk acceptance.

19 C is correct. Among the risk-modification methods of risk avoidance, risk acceptance, risk transfer, and risk shifting none has a clear advantage. One must weigh benefits and costs in light of the firm's risk tolerance when choosing the method to use.

PRACTICE PROBLEMS

1 Technical analysis relies most importantly on:
   A price and volume data.
   B accurate financial statements.
   C fundamental analysis to confirm conclusions.

2 Which of the following is *not* an assumption of technical analysis?
   A Security markets are efficient.
   B The security under analysis is freely traded.
   C Market trends and patterns tend to repeat themselves.

3 Drawbacks of technical analysis include which of the following?
   A It identifies changes in trends only after the fact.
   B Deviations from intrinsic value can persist for long periods.
   C It usually requires detailed knowledge of the financial instrument under analysis.

4 Why is technical analysis especially useful in the analysis of commodities and currencies?
   A Valuation models cannot be used to determine fundamental intrinsic value for these securities.
   B Government regulators are more likely to intervene in these markets.
   C These types of securities display clearer trends than equities and bonds do.

5 A daily bar chart provides:
   A a logarithmically scaled horizontal axis.
   B a horizontal axis that represents changes in price.
   C high and low prices during the day and the day's opening and closing prices.

6 A candlestick chart is similar to a bar chart *except* that the candlestick chart:
   A represents upward movements in price with X's.
   B also graphically shows the range of the period's highs and lows.
   C has a body that is light or dark depending on whether the security closed higher or lower than its open.

7 In analyzing a price chart, high or increasing volume *most likely* indicates which of the following?
   A Predicts a reversal in the price trend.
   B Predicts that a trendless period will follow.
   C Confirms a rising or declining trend in prices.

8 In constructing a chart, using a logarithmic scale on the vertical axis is likely to be *most useful* for which of the following applications?
   A The price of gold for the past 100 years.
   B The share price of a company over the past month.
   C Yields on 10-year US Treasuries for the past 5 years.

9 A downtrend line is constructed by drawing a line connecting:
   A the lows of the price chart.

B the highs of the price chart.

C the highest high to the lowest low of the price chart.

10 Exhibit 1 depicts GreatWall Information Industry Co., Ltd., ordinary shares, traded on the Shenzhen Stock Exchange, for late 2008 through late 2009 in renminbi (RMB).

Exhibit 1 Candlestick Chart: GreatWall Information Industry Co., Ltd. Price Data, November 2008–September 2009 (Price Measured in RMB × 10)

Based on Exhibit 1, the uptrend was *most likely* broken at a price level nearest to:

A 7 RMB.

B 8.5 RMB.

C 10 RMB.

11 The "change in polarity" principle states which of the following?

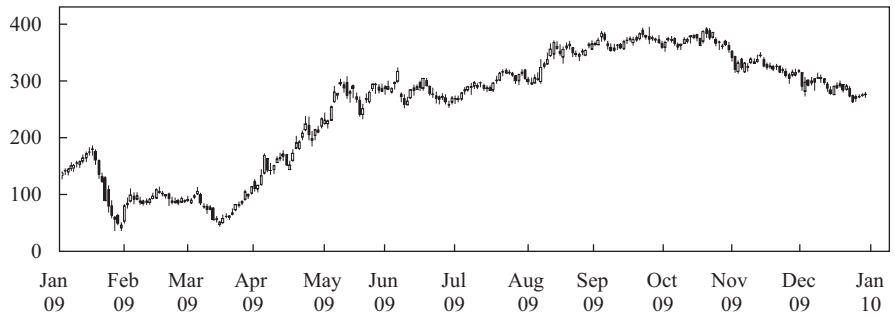
A Once an uptrend is broken, it becomes a downtrend.

B Once a resistance level is breached, it becomes a support level.

C The short-term moving average has crossed over the longer-term moving average.

12 Exhibit 2 depicts Barclays ordinary shares, traded on the London Stock Exchange, for 2009 in British pence.

Exhibit 2 Candlestick Chart: Barclays plc Price Data, January 2009–January 2010 (Price Measured in British Pence)



Based on Exhibit 2, Barclays appears to show resistance at a level nearest to:

A 50p.

B 275p.

C 390p.

13 Exhibit 3 depicts Archer Daniels Midland Company common shares, traded on the New York Stock Exchange, for 1996 to 2001 in US dollars.

Exhibit 3 Candlestick Chart: Archer Daniels Midland Company, February 1996–February 2001

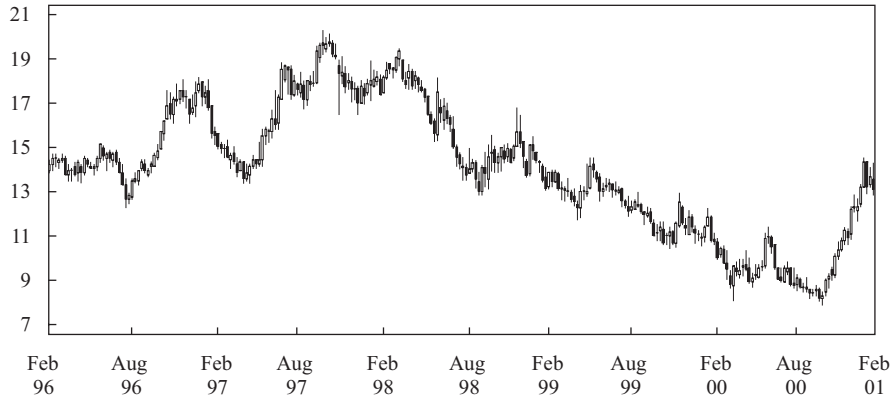


Exhibit 3 illustrates *most* clearly which type of pattern?

A Triangle.

B Triple top.

C Head and shoulders.

14 In an inverted head and shoulders pattern, if the neckline is at €100, the shoulders at €90, and the head at €75, the price target is *closest* to which of the following?

A €50.

B €110.

C €125.

15 Which flow-of-funds indicator is considered bearish for equities?

A A large increase in the number of IPOs.

B Higher-than-average cash balances in mutual funds.

C An upturn in margin debt but one that is still below the long-term average.

16 A TRIN with a value of less than 1.0 indicates:

A the market is in balance.

B there is more volume in rising shares.

C there is more volume in declining shares.

17 Bollinger Bands are constructed by plotting:

A a MACD line and a signal line.

B a moving-average line with an uptrend line above and downtrend line below.

C a moving-average line with upper and lower lines that are at a set number of standard deviations apart.

18 Which of the following is *not* a momentum oscillator?

A MACD.

B Stochastic oscillator.

C Bollinger Bands.

19 Which of the following is a continuation pattern?

A Triangle.

B Triple top.

C Head and shoulders.

20 Which of the following is a reversal pattern?

A Pennant.

B Rectangle.

C Double bottom.

21 Which of the following is generally true of the head and shoulders pattern?

A Volume is important in interpreting the data.

B The neckline, once breached, becomes a support level.

C Head and shoulders patterns are generally followed by an uptrend in the security's price.

22 Nikolai Kondratieff concluded in the 1920s that since the 1780s, Western economies have generally followed a cycle of how many years?

A 18.

B 54.

C 76.

23 Based on the decennial pattern of cycles, how would the return of the Dow Jones Industrial Average (DJIA) in the year 2015 compare with the return in 2020?

A The return would be better.

B The return would be worse.

C The answer cannot be determined because the theory does not apply to both of those years.

24 According to the US presidential cycle theory, the DJIA has the best performance during which year?

A The presidential election year itself.

B The first year following a presidential election.

C The third year following a presidential election.

25 What is a major problem with long-term cycle theories?

A The sample size is small.

B The data are usually hard to observe.

C They occur over such a long period that they are difficult to discern.

26 In 1938, R. N. Elliott proposed a theory that equity markets move:

A in stochastic waves.

B in cycles following Fibonacci ratios.

C in waves dependent on other securities.

27 All of the following are names of Elliott cycles *except*:

A presidential.

B supercycle.

C grand supercycle.

28 To identify intermarket relationships, technicians commonly use:

A stochastic oscillators.

B Fibonacci ratios.

C relative strength analysis.

SOLUTIONS

1 A is correct. Almost all technical analysis relies on these data inputs.

2 A is correct. Technical analysis works because markets are *not* efficient and rational and because human beings tend to behave similarly in similar circumstances. The result is market trends and patterns that repeat themselves and are somewhat predictable.

3 A is correct. Trends generally must be in place for some time before they are recognizable. Thus, some time may be needed for a change in trend to be identified.

4 A is correct. Commodities and currencies do not have underlying financial statements or an income stream; thus, fundamental analysis is useless in determining theoretical values for them or whether they are over- or undervalued.

5 C is correct. The top and bottom of the bars indicate the highs and lows for the day; the line on the left indicates the opening price and the line on the right indicates the closing price.

6 C is correct. Dark and light shading is a unique feature of candlestick charts.

7 C is correct. Rising volume shows conviction by many market participants, which is likely to lead to a continuation of the trend.

8 A is correct. The price of gold in nominal dollars was several orders of magnitude cheaper 100 years ago than it is today (roughly US$20 then versus US$1,100 today). Such a wide range of prices lends itself well to being graphically displayed on a logarithmic scale.

9 B is correct. A downtrend line is constructed by drawing a line connecting the highs of the price chart.

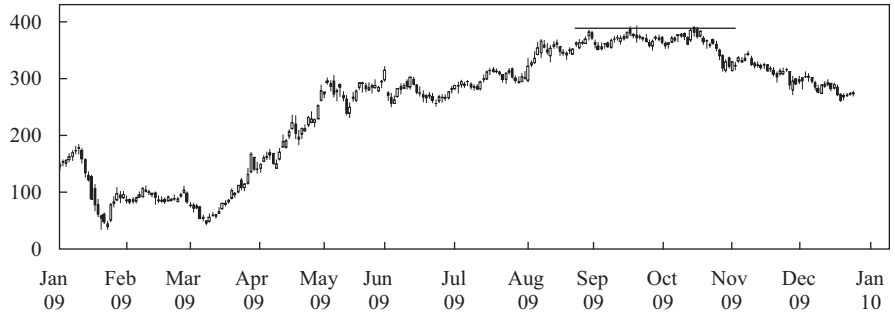
10 B is correct. It is demonstrated in the following chart:

Exhibit 1 Candlestick Chart: GreatWall Information Industry Co., Ltd. Price Data, November 2008–September 2009 (Price Measured in RMB × 10)

11 B is correct.

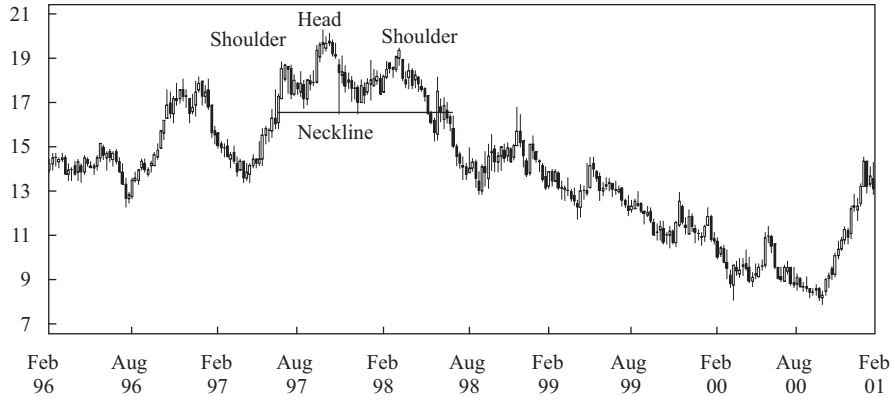
12 C is correct. As shown in the following chart, Barclays shares traded up to 390p on three occasions, each several weeks apart, and declined thereafter each time.

Exhibit 2 Candlestick Chart: Barclays plc Price Data, January 2009–January 2010 (Price Measured in British Pence)



13 C is correct. The left shoulder formed at around US$18.50, the head formed at around US$20.50, and the second shoulder formed at around US$19.

Exhibit 3 Candlestick Chart: Archer Daniels Midland Company, February 1996–February 2001



14 C is correct. Target = Neckline + (Neckline – Head): €100 + (€100 – €75) = €125

15 A is correct. A large increase in the number of IPOs increases the supply of equity and if overall demand remains the same, puts downward pressure on equities. Also, companies tend to issue shares of equity when the managers believe they will receive a premium price, which is also an indicator of a market top.

16 B is correct. A value below 1.0 is a bullish sign; it means more volume is in rising shares than in declining ones. The TRIN is calculated as: (Advancing issues/Declining issues)/(Volume of advancing issues/Volume of declining issues).

17 C is correct. Bollinger Bands consist of a moving average and a higher line representing the moving average plus a set number of standard deviations from average price (for the same number of periods as used to calculate the moving average) and a lower line that is a moving average minus the same number of standard deviations.

18 C is correct. Bollinger Bands are price-based indicators, *not* momentum oscillators, which are constructed so that they oscillate between a high and a low or around 0 or 100.

19 A is correct. Triangles are one of several continuation patterns.

20 C is correct. It is one of several reversal patterns.

21 A is correct. Volume is necessary to confirm the various market rallies and reversals during the formation of the head and shoulders pattern.

22 B is correct.

23 A is correct. The decennial pattern theory states that years ending with a 5 will have the best performance of any of the 10 years in a decade and that those ending with a zero will have the worst.

24 C is correct. A possible reason for the superior performance in the third year is that the US presidential election occurs, together with a number of other elections, in a four-year cycle, so the politicians desiring to be reelected inject money into the economy in the third year to improve their chances of winning the following year.

25 A is correct. Long-term cycles require many years to complete; thus, not many cycles are available to observe.

26 B is correct.

27 A is correct. This is the term for a separate cycle theory.

28 C is correct. Relative strength analysis is often used to compare two asset classes or two securities.

PRACTICE PROBLEMS

1 A correct description of fintech is that it:
   - **A** is driven by rapid growth in data and related technological advances.
   - **B** increases the need for intermediaries.
   - **C** is at its most advanced state using systems that follow specified rules and instructions.

2 A characteristic of Big Data is that:
   - **A** one of its traditional sources is business processes.
   - **B** it involves formats with diverse types of structures.
   - **C** real-time communication of it is uncommon due to vast content.

3 In the use of machine learning (ML):
   - **A** some techniques are termed "black box" due to data biases.
   - **B** human judgment is not needed because algorithms continuously learn from data.
   - **C** training data can be learned too precisely, resulting in inaccurate predictions when used with different datasets.

4 Text Analytics is appropriate for application to:
   - **A** economic trend analysis.
   - **B** large, structured datasets.
   - **C** public but not private information.

5 In providing investment services, robo-advisers are *most likely* to:
   - **A** rely on their cost effectiveness to pursue active strategies.
   - **B** offer fairly conservative advice as easily accessible guidance.
   - **C** be free from regulation when acting as fully-automated wealth managers.

6 Which of the following statements on fintech's use of data as part of risk analysis is correct?
   - **A** Stress testing requires precise inputs and excludes qualitative data.
   - **B** Machine learning ensures that traditional and alternative data are fully segregated.
   - **C** For real-time risk monitoring, data may be aggregated for reporting and used as model inputs.

7 A factor associated with the widespread adoption of algorithmic trading is increased:
   - **A** market efficiency.
   - **B** average trade sizes.
   - **C** trading destinations.

8 A benefit of distributed ledger technology (DLT) favoring its use by the investment industry is its:
   - **A** scalability of underlying systems.
   - **B** ease of integration with existing systems.
   - **C** streamlining of current post-trade processes.

9 What is a distributed ledger technology (DLT) application suited for physical assets?

A Tokenization

B Cryptocurrencies

C Permissioned networks

SOLUTIONS

1 A is correct. Drivers of fintech include extremely rapid growth in data (including their quantity, types, sources, and quality) and technological advances enabling the capture and extraction of information from it.

2 B is correct. Big Data is collected from many different sources and is in a variety of formats, including structured data (e.g., SQL tables or CSV files), semi-structured data (e.g., HTML code), and unstructured data (e.g., video messages).

3 C is correct. Overfitting occurs when the ML model learns the input and target dataset too precisely. In this case, the model has been "over trained" on the data and is treating noise in the data as true parameters. An ML model that has been overfitted is not able to accurately predict outcomes using a different dataset and may be too complex.

4 A is correct. Through the Text Analytics application of natural language processing (NLP), models using NLP analysis may incorporate non-traditional information to evaluate what people are saying—via their preferences, opinions, likes, or dislikes—in the attempt to identify trends and short-term indicators about a company, a stock, or an economic event that might have a bearing on future performance.

5 B is correct. Research suggests that robo-advisers tend to offer fairly conservative advice, providing a cost-effective and easily accessible form of financial guidance to underserved populations, such as the mass affluent and mass market segments.

6 C is correct. There is increasing interest in monitoring risk in real-time. To do so, relevant data must be taken by a firm, mapped to known risks, and identified while moving within the firm. Data may be aggregated for reporting purposes or used as inputs to risk models.

7 C is correct. Global financial markets have undergone substantial change as markets have fragmented into multiple trading destinations consisting of electronic exchanges, alternative trading systems, and so-called dark pools. In such an environment, when markets are continuously reflecting real-time information and continuously changing conditions, algorithmic trading has been viewed as an important tool.

8 C is correct. DLT has the potential to streamline the existing, often complex and labor intensive post-trade processes in securities markets by providing close to real-time trade verification, reconciliation, and settlement, thereby reducing related complexity, time, and costs.

9 A is correct. Through tokenization—the process of representing ownership rights to physical assets on a blockchain or distributed ledger—DLT has the potential to streamline this rights process by creating a single, digital record of ownership with which to verify ownership title and authenticity, including all historical activity.